Usenet Newsgroup Archive: rec.radio.amateur.digital.misc

2013

These Usenet messages were preserved as a plain-text archive. This PDF was generated by Digital Library of Amateur Radio & Communications from the source text file in 2026.

Date span: 2013-01-09 through 2013-05-04

Source text: rec.radio.amateur.digital.misc.txt

Source item: https://archive.org/details/usenet-rec

Messages included in this PDF: 20

Messages are presented chronologically by archived date.

Binary or encoded payloads are not printed as blocks of encoded text; a placeholder appears where such material was detected. The original source text is unchanged.

1. [tapr-announce] Working on the newsletter

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-01-09 01:36:17 UTC
From: Stan Horzepa <stanzepa@sbcglobal.net>
Message-ID: <50ECC963.9020504@sbcglobal.net>
Source record: 131
Cross-posted to: rec.radio.amateur.digital.misc,rec.radio.info

Now that the holidays are behind us, the staff of TAPR's quarterly newsletter PSR is now preparing the next issue. If you would like to contribute anything to the next issue of PSR, now is the time to get your contribution together and send it off to the PSR editorwa1lou@tapr.org

I look forward to your input!

73,

WA1LOU

_____
tapr-announce mailing list

NOTE: This list includes all addresses currently subscribed to any TAPR mailing list. Please don't try to manually unsubscribe from this list; it won't work. If you unsubscribe from all other TAPR mailing lists, you will automatically be unsubscribed from this one.

2. [tapr-announce] CORRECTION: Working on the newsletter

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-01-09 12:49:09 UTC
From: Stan Horzepa <stanzepa@sbcglobal.net>
Message-ID: <50ED6659.3030800@sbcglobal.net>
Source record: 132
Cross-posted to: rec.radio.amateur.digital.misc,rec.radio.info

My e-mail address got messed up in the original posting of this message, so here it is again:

Now that the holidays are behind us, the staff of TAPR's quarterly newsletter PSR is now preparing the next issue.

If you would like to contribute anything to the next issue of PSR, now is the time to get your contribution together and send it off to the PSR editor: wa1lou@tapr.org

I look forward to your input!

73,

WA1LOU
wa1lou@tapr.org

_____
tapr-announce mailing list

NOTE: This list includes all addresses currently subscribed to any TAPR mailing list. Please don't try to manually unsubscribe from this list; it won't work. If you unsubscribe from all other TAPR mailing lists, you will automatically be unsubscribed from this one.

3. 30 Years Ago: Early TAPR and TNC History

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-01-11 17:46:01 UTC
From: "Paul W. Schleck" <pschleck@oasis.novia.net>
Message-ID: <50f04deb$0$61634$540ea2cf@novia.net>
Source record: 133
Cross-posted to: rec.radio.amateur.moderated,rec.radio.amateur.digital.misc

```
-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA1

This is from a web-site that is replaying Usenet, including
net.ham-radio, from 30 years ago (currently early 1983). The site is:

http://www.olduse.net

If you prefer to use your own newsreader, the site also supports an NNTP
connection at:

nntp.olduse.net:119

>From: karn <utzoo!decvax!harpo!eagle!karn>
>Subject: TAPR Experiments Document
>Newsgroups: net.ham-radio
>Date: Mon Jan 10 23:46:39 1983

LOCAL AREA NETWORKS VIA PACKET RADIO MEDIUM

Den Connors

University Computer Center
University of Arizona, Tucson, Arizona

Abstract

Investigations are underway by the Amateur
Radio community to incorporate digital communica-
tions techniques into the Amateur Service. The
network system utilizes simple techniques, using
normal terminals and personal computers, and a wide
variety of amateur radio transceivers. Complete
local area network protocols are realized by
incorporating a micro-processor based interface
unit to connect the terminal device and radio.
Physical-level protocol involves half-duplex trans-
missions with frequency-modulated transceivers.
Channel activity is sensed by the packet radio, and
negative acknowledgement used to determine if
retransmission of lost packets is required. A
data-link control is also implemented, and two
connecting protocols are being tested on top of
these lower levels. The TAPR/AMSAT protocol
provides multiple point-to-point connections on the
channel. The TAPR/DA (dynamic-addressing) protocol
```

implements a full datagram network, and uses a robust network control scheme to provide near-optimum channel utilization and network tolerance to a number of error conditions related to open radio channels.

Introduction

The Tucson Amateur Packet Radio group is currently coordinating a series of tests with Amateur Radio operators in eighteen major U.S. cities, to investigate the use of digital computer and terminal communications using packet radio techniques. Initial investigations are being performed on the Amateur Radio Service VHF bands, using half-duplex transmissions. Two sets of experiments are being undertaken; the first is testing multiple simultaneous connections on a single shared frequency, while the second tests a new form of efficient radio frequency local area network.

A general description of the system is given in terms of the signals and medium access. This is followed by information on the hardware implementation. A more detailed description of the signalling technique, data link protocol and the two types of link and network protocols are described.

Physical and Medium Access Protocols

Both protocol tests are using a common medium. Access to the radio channel is accomplished using audio frequency shift keying within the normal audio communications passband. The packet radios are able to detect digital communications on the channel, and will defer transmissions while there is activity on the channel. Collisions, interference and unusual conditions (fading, multipath, etc.) which cause unsuccessful transmissions will result in no acknowledgement, and an automatic retransmission will result after a set delay. Multiple unsuccessful transmissions will produce an error indication at the data source. Successful transmissions will result in an acknowledgement being transmitted to the originating station. The acknowledgements may occur after each packet, or may be deferred for up to seven packets, using standard high-level bit-oriented data link protocol (HDLC), implemented with large-scale integrated circuitry.

This multiple-access protocol is therefore based on on-channel data sensing, with negative acknowledgement causing retransmission (data-sensed multiple-access with collision-detection by negative acknowledgement, or DSMA/NAK). It should be noted that the normal LAN technique of carrier-sensing is not appropriate to the Amateur Radio Service, where all manner of signals are apt to impinge on the data channel. Use of much less occupied bands is possible, and conversion to carrier-sensing trivial. However, the choice of using the more heavily-used bands was made to provide exposure to the general population, and promote acceptance of this new mode.

Hardware

The Tucson Amateur Packet Radio Corporation (TAPR) has created a single-board packet radio terminal node controller (TNC) which interfaces standard microcomputers or data terminals to commonly available Amateur Radio transceivers.

Initial investigations in Tucson are using the two-meter band (144-148MHz), and both this band and others will be used in the other seventeen test sites. This band was chosen for maximum visibility within the Amateur community.

The transceiver interface is performed without modification to the unit by using the three normally-available signal lines; audio input (microphone), audio out (speaker) and transmit (push-to-talk). This ease of equipment configuration was the primary reason to use audio-frequency shift keying, and to keep the modulating signals within the audio passband.

The digital data from the terminal or computer is fed to the packet radio interface board either through a standard RS-232 serial interface port, or by using a custom parallel interface. TTL-level lines are provided on the board for these connections, and a wire-wrap area is also included for non-standard interconnects.

The TNC accepts the serial or parallel data and formats the data into packets, using the standard HDLC format as described below. These serial packets are encoded using a non-return-to-zero inverted (NRZI) code to assist in providing an audio signal for the demodulator to lock on, using phase-locked loops. This NRZI data is

presented to the audio FSK modulator, and the modulated signal is fed to the audio input of the transceiver.

The received signal appears as an AFSK signal on the audio output of the radio. A side benefit of using standard Amateur radios is the availability of a speaker for monitoring the channel while the experiments are in progress, although experience suggests that continued monitoring can be most distracting.

The signalling tones used to modulate the radio were chosen to be compatible with those of the Bell 202 half-duplex modem set of standards. This was done both to use a well-tested pair of frequencies with much operating experience, and to allow earlier experimenters with surplus 202-type modems to use their equipment, expanding the size of the test community. The main drawback to the 202-type modem is the limitation of 1200 bits/second of data transmission. Further experimentation is planned for higher-speed phase-shift keying modems within radios built expressly for packet radio service.

Hardware also exists on board to handle packet encoding and decoding, buffering, and system initialization and calibration. All components necessary to provide the channel access and data link control, as well as network protocol, are also contained on the TNC. A built-in modem and power supply minimize the complexity of installation.

Data Link Control

Both protocols being investigated use similar data-link protocols, although there are differences in addressing modes. An HDLC controller integrated circuit provides most of the circuitry for building and disassembling the packets. HDLC framing signals, address bytes, control byte and trailing cyclic redundancy check bytes are employed without modification. Successful packets are acknowledged on receipt, using standard HDLC control modes. Each packet is checked for correct CRC calculation, and the acknowledgement packet is withheld if the CRC is incorrect. This forces a retransmission by the source station. Retransmitted packets are thereby forced either by incorrect CRC calculation or by having been interfered with (collisions or unwanted signals). Collisions of packets are

minimized by the data-sensing capabilities of the packet radios.

The decision of the next time to retransmit a packet will be weighted by a binary-exponent random back-off algorithm, similar to that used by Ethernet-like systems. This minimizes the possibility of continuing collisions by radios with nearly-synchronous retransmission attempts.

Unlike most LAN media, the open radio channel susceptibility to intentional and unintentional interference adds complexity to the link-level algorithms used to reschedule transmissions. Another problem is the phenomenon of "capture" of the receiver demodulator by FM signals stronger than that of the desired signal.

Connection-Oriented Protocol

The first protocol used to exercise the packet radio system was one developed simultaneously by groups in the Los Angeles and Washington, D.C. areas, and approved and "standardized" at a meeting sponsored by the Radio Amateur Satellite Corporation (AMSAT) in October of 1982. The implementation of this TAPR/AMSAT protocol provides a means of connecting pairs of packet radios with a communication channel transparent to other users of the shared channel. While lacking some of the capabilities of a full local area network, this protocol nonetheless provides a means of experimenting with channel capacity, access algorithms and system parameters.

The TAPR/AMSAT implementation provides the same types of functions as the link-access protocol of X.25. Connection and disconnection, error indications and control, and flow control are all provided. Virtual circuits are supported on the channel and channel-wide monitoring is available.

The addressing scheme is unique, in that the Amateur Radio Service has associated with each station a single call sign, that of the station owner/operator. The packet radios have made use of this uniqueness to provide unambiguous addressing, both within LAN's and across future internetwork gateways. A serious drawback is the requirement of seven bytes for both sending and receiving addresses, but on the half-duplex channels currently in use, this added overhead is not

noticeable.

A further enhancement allows extension of the network to larger geographical areas with any of the stations acting as a store-and-forward packet repeater. Stations requiring repeat services use bits in the HDLC control word to signal the need to have a message repeated, and repeated messages turn off this bit to prevent possible multiple acknowledgements.

Although this protocol is designed primarily for point-to-point links within a larger multi-point network configuration, it does lend itself well to some of the needs of the shared-channel packet system, including terminal-to-host and host-to-host connections.

Datagram Protocol with Dynamic Addressing

The second protocol being used in the packet radio experiment test beds has a more efficient addressing scheme, providing each station with a mechanism to obtain a one-byte address when first accessing the network. This dynamic-addressing protocol, called TAPR/ DA, provides a full network configuration with connectionless protocol and a centralized, failure-tolerant network control mechanism.

The unique aspect of this LAN protocol is this utilization of dynamic address allocation. A network control station (NCS) monitors for stations attempting to sign on, and replaces the amateur radio call sign sent to the NCS with a single byte address for efficiency. Each station then has available from the NCS a list of users (amateur call signs) and corresponding assigned addresses. This list is the system status table. For robustness and ease of switching to other radio channels, the first station on any given frequency will automatically be chosen as the NCS, and in the event of loss of this station, the next station attempting transmissions which require the NCS will become the NCS.

This protocol also supports a store-and-forward repeat capability. The possibility of hearing stations in a different network geo-graphically remote, but using the same frequency requires special algorithms. The conditions of multiple store-and-forward digipeaters, network

control stations or identically-addressed stations must be detected and corrected.

Future Research

Currently experiments are underway to further extend network topology through the use of specified stations as network-to-network links, using separate radio channels. Additionally, the use of amateur radio satellites is being planned.

Acknowledgements

The author wishes to acknowledge the efforts of Lyle Johnson, who is the principal architect of the terminal node controller hardware. Margaret Morrison, Harold Price and David Henserson wrote the TAPR/AMSAT software for the system, and Marcus Chamberlin and David McClain produced the TAPR/DA software. Design credit also goes to all of the above, as well as Charles Green, Mark Baker and Dan Morrison for several design concepts. Further gratitude is given to the 180 hams who have volunteered a wide variety of resources to help test the system.

>From: karn <utzoo!decvax!harpo!eagle!karn>
>Subject: TAPR Status
>Newsgroups: net.ham-radio
>Date: Mon Jan 10 23:47:13 1983

By Lyle Johnson WA7GXD, and Dan Morrison KV7B

BLACK THURSDAY

All was going well. The parts were in hand, PC boards delivered and volunteer (slave) labor lined up for the BIG PUSH -- would you believe Beta TNCs in time for Christmas?

Neither would Murphy! On Wednesday, 8 December 1982, the first TNCs were delivered to TAPR from one of the two assembly plants. The first one worked perfectly! Unfortunately, by 2:00 AM, Thursday, 9 December, a serious problem was very apparent. "Black Thursday" was upon us. Only 3 of the first 19 TNCs were functional.

After a fitful (morning's) rest, an emergency meeting of the TAPR executives was called, production halted, and an investigation into Murphy's doings launched.

It turned out that there was a problem in the plate-through job on the PC boards, meaning that the top half and the bottom half of the board were intermittently (dis)connected. The 119 TNCs assembled by the time of the halt in production were sent to the scrap bin, and an assessment of the damages made. The losses were a staggering $8600!

TAPR, being in no position to absorb such a blow, determined to finish the project anyway. A salvage operation was mounted, and in the end there is a $3000 loss to contend with -- not insubstantial, but one that, with a judicious amount of finagling, and some voluntary $upport from those interested in seeing this thing through, can be overcome. New boards were ordered fabricated (free) and parts to populate the boards re-ordered.

After a few slips in the schedule, 10 boards were received the week of 28 December 1982. Two were hand-assembled by WA7GXD, and worked the first time. Three were assembled by one of the two assembly plants, wave-soldered and delivered. All three worked!

The delay time was used by both the software group, for additional debugging and refinement, and the hardware group, for additional testing and interfacing. Meanwhile, the approximately 70-page TNC Manual is being edited and clarified.

The present schedule calls for board assembly to begin the week of 9 January with assemblies delivered to TAPR late in the week of 16 January. The boards will then be powered up and power supply voltages checked. Passing this test, the ICs will be loaded and calibration performed on the MODEM. Finally, the TNC will "connect" to itself via a digipeater, then be packed up, along with the manual, for shipment to the Beta coordinator. The Beta coordinator will then be responsible for distribution of the TNCs to the individual site participants.

It has often been asked if the TAPR TNCs will be compatible with the Vancouver TNCs, and the answer is an emphatic YES! Harold Price, NK6K and co-author of the high-level PASCAL software, established a connection with Skip Hanson, WB6YMH, in Los Angeles on 8 January 1983. Harold was using a Beta TNC, while Skip used a VADCG TNC. Packets were exchanged for a half-hour or so, and the test was a complete success!

The initial software released with the Beta boards is a version of the AMSAT protocol agreed upon in

Washington DC the weekend of October 8th, in addition to the more-or-less standard Vancouver protocol in general use. The software is outlined in more detail below.

SOFTWARE UPDATE

This update would be written by Margaret, KV7D, rather than by me (KV7B), except that as these words are being composed she is putting the last bells and whistles in the TAPR/AMSAT AX.25 level 2 protocol software which will appear on the TAPR Beta board at time of distribution. The people responsible for this monumental effort are: Dave Henderson, KD4NL, who was responsible for implementing the protocol; Margaret Morrison, KV7D, who put together the entire package of real-time assembly language routines and debugger; and Harold Price, NK6K, who built the extremely flexible command parsing language. Of the 24k bytes of PROM on board, 22k are used in this release. The high-level routines were written in compiled Pascal, and occupy about 16k of the total. The entire development time was roughly from the AX.25 protocol meeting in October until today (mid-January).

The simplest description of the software is that it's everything any of us dared to hope for and more. Not only does it implement AX.25 level 2 protocol "by the book," (it follows the October 10 document produced at the AMSAT meeting, based on the AMRAD recommendations; and where ambiguities exist, follows Ma Bell's BX.25, issue 2 document), but it can also operate in Vancouver compatibility mode with no problems.

Present at this time are some 66 user settable parameters for controlling the behavior of the board, many of them for determining the details of terminal communication. In this short space only a few highlights may be mentioned, but they include such items as hardware and software flow control, separately controllable in either direction, with the software flow control characters being user definable. In order to permit total transparency a single command defeats all special character traps and packetizes according to timer and packet length criteria. At the other extreme, input editing at the character and line level are available, including a separate "cancel packet" command.

Perhaps the most important features are the elaborate timer operated CSMA procedures, including (all user settable) separate key-up delays for digipeating

and originating packets, separate delays for voice repeater key-up and tail-drop times, and random wait times after collisions. Flow control on the RF link also involves time delays. Altogether, there are ten distinct timer functions associated with the RF link, requiring 4 separate clocks to be maintained by the interrupt driven routines.

All in all, the functions presently on board should be more than adequate for the "shakedown cruise" coming up during Beta Test, and future releases will have even more features (we've still got 2k PROM to go before adding the next deck to the board!).

-----BEGIN PGP SIGNATURE-----
Version: GnuPG v2.0.19 (FreeBSD)

iEYEARECAAYFAlDwTYYACgkQ6Pj0az779o76xwCeNzIMCCQoLaNDrPpnLuZ8JZbN
gHEAoKEkJZx4wi+H0QVhfOoRPUtL3vtj
=xZuE
-----END PGP SIGNATURE-----

4. [tapr-announce] TAPR.ORG server upgrade

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-01-17 00:38:49 UTC
From: John Ackermann N8UR <jra@febo.com>
Message-ID: <50F747BB.3060905@febo.com>
Source record: 134
Cross-posted to: rec.radio.amateur.digital.misc,rec.radio.info

On January 16th, we moved the TAPR internet server to new hardware.
Hopefully the mail, mailing list, web, and ftp services will operate
just like they did before, though the IP address has changed and it may
take a day or so for the new data to make it to all the name servers.

The svn service is still running on the old machine and IP address; it
will be moved in the next couple of days.

In the process of the move, we may have lost about a weeks worth of
mailing list archives. We'll see if we can reconstruct the archive, but
it may not be practical. Sorry about that. Some subscription updates
may also have been lost.

Some fine-tuning continues so we apologize in advance for any hiccups
you see over the next few days.

Jeremy McDermond stepped in on short notice to manage the transition,
and did a great job. Thanks, Jeremy!

73,
John N8UR

_____
tapr-announce mailing list

NOTE: This list includes all addresses currently subscribed to any TAPR mailing list.
Please don't try to manually unsubscribe from this list; it won't work. If you unsubscribe
from all other TAPR mailing lists, you will automatically be unsubscribed from this one.

5. 30 Years Ago: AMSAT/VITA Agreement to Develop PACSAT

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-01-19 01:24:19 UTC
From: "Paul W. Schleck" <pschleck@oasis.novia.net>
Message-ID: <50f98425$0$61560$540ea2cf@novia.net>
Source record: 135
Cross-posted to: rec.radio.amateur.moderated,rec.radio.amateur.space,rec.radio.amateur.digital.misc

-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA1

This is from a web-site that is replaying Usenet, including
net.ham-radio, from 30 years ago (currently early 1983). The site is:

http://www.olduse.net

If you prefer to use your own newsreader, the site also supports an NNTP
connection at:

nntp.olduse.net:119

>From: karn <utzoo!decvax!harpo!eagle!karn>
>Subject: Amsat/Vita agreement
>Newsgroups: net.ham-radio, net.space
>Date: Mon Jan 17 21:11:48 1983

Jan 14,1983 -- The Radio Amateur Satellite Corp. (AMSAT) and the
Volunteers In Technical Assistance (VITA) {note -- pronounce as
VI-TAH as in the word vital} have today announced their intent
to pursue a joint effort to develop a low-cost packet radio
satellite system called PACSAT.

VITA, headquartered in Rosslyn, VA, is a private, nonprofit
organization that supports people working on technical problems
in developing countries with technical information provided by
thousands of volunteer scientists, engineers and technologists.
The information and assistance VITA provides is aimed at helping
local people in developing countries to select and implement
technologies appropriate to their local situations.

VITA Director Henry Norman and VITA Project Coordinator Dr. Gary
Garriott (WA9FMQ) today announced that VITA has just awarded
AMSAT a $15,000 Design Definition Grant to support development of
PACSAT as a reliable low-cost digital satellite system to meet
requirements for communications of technical information on
renewable energy resources to and from their many field
locations. AMSAT's role in this joint activity will be to provide
hardware suitable for demonstration programs and to provide
technical assistance in developing a low-cost system. Part of
this effort will involve adapting solar power, amateur radio and
personal computer technology for use in the field, far removed
from any technical support.

AMSAT's PACSAT project manager Den Connors (KD2S) indicated that this grant will support initial PACSAT design definition activities which are being coordinated by AMSAT with work being done in some 15 locations around the world.

It is also of interest to note that WA9FMQ is a cousin of NASA astronaut Dr. Owen Garriott, W5LFL who may be amateur radio's first "space mobile" by operating from the Space Shuttle if a proposal submitted by AMSAT and ARRL is approved by NASA.

AMSAT
850 Sligo Ave.
Silver Spring, MD 20910

VITA
1815 North Lynn St.
Rosslyn VA 22209

-----BEGIN PGP SIGNATURE-----
Version: GnuPG v2.0.19 (FreeBSD)

iEYEARECAAYFAlD5g9cACgkQ6Pj0az779o5hIQCg0U+d+ll9294kray0pw219Bu2
+MIAnjK7ADXiG/flSjyBKVW+pxcNanFX
=bRuX
-----END PGP SIGNATURE-----

6. [tapr-announce] PSR: last call

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-01-19 21:20:47 UTC
From: Stan Horzepa <stanzepa@sbcglobal.net>
Message-ID: <50FB0D17.4050009@sbcglobal.net>
Source record: 136
Cross-posted to: rec.radio.amateur.digital.misc,rec.radio.info

We received some excellent articles for the next issue of PSR (Packet
Status Register), TAPR's quarterly newsletter, but there is always room
for one more! The editorial staff will be putting the next issue
together during the next few weeks, but if you have anything you would
like to add, please send it along and we will make sure it gets in.

Thanks and 73,

WA1LOU PSR Editor
wa1lou@tapr.org

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tapr-announce mailing list

NOTE: This list includes all addresses currently subscribed to any TAPR mailing list.
Please don't try to manually unsubscribe from this list; it won't work. If you unsubscribe
from all other TAPR mailing lists, you will automatically be unsubscribed from this one.

7. Ham Radio Now for Sunday 20 January 2013

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-01-20 15:45:50 UTC
From: rec-radio-info-request@panix.com
Message-ID: <20cf303bfab8d8d36704d3b49838@google.com>
Source record: 137
Cross-posted to: rec.radio.amateur.misc,rec.radio.amateur.digital.misc,rec.radio.info

Ham Radio Now

//
HamRadioNow: GNU Radio Intro (from the DCC); Tale of Two Hamfests

Posted: 19 Jan 2013 08:55 AM PST
http://hamradionow.tv

Episode 51: Introduction to GNU Radio

The four-hour "deep dive" from the DCC

The GNU Radio Project is a development and experimentation platform for the software behind Software Defined Radio.Tom Rondeau KB3UKZ is the project leader, and he presents this four-hour talk as the Sunday Seminar from the 2012 ARRL & TAPR Digital Communications Conference, held last September in Atlanta.

Episode 52: A Tale of Two... Three Hamfests

Sunday Is Dead. Long Live Friday! As more hamfests abandon Sunday in favor of Friday, Gary talks to the chairmen of two of them – the newly reborn Miami Hamfest (aka Tropical Hamboree), and Charlotte. Then he dissects the Shelby NC hamfests's move back to the county fairgrounds they abandoned five years ago. Let the Hamfest Season begin!

8. 30 Years Ago: FCC Authorizes AMTOR for Amateur Radio HF Bands

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-02-03 17:59:02 UTC
From: "Paul W. Schleck" <pschleck@oasis.novia.net>
Message-ID: <510e913a$0$71836$540ea2cf@novia.net>
Source record: 138
Cross-posted to: rec.radio.amateur.moderated,rec.radio.amateur.digital.misc,rec.radio.amateur.policy

```
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Hash: SHA1

This is from a web-site that is replaying Usenet, including
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http://www.olduse.net

If you prefer to use your own newsreader, the site also supports an NNTP
connection at:

nntp.olduse.net:119

>From: ad7i <utzoo!decvax!harpo!npoiv!npois!houxm!houxa!houxb!houxq!houxp!ad7i>
>Subject: ARRL 10: AMTOR
>Newsgroups: net.ham-radio
>Date: Wed Feb 2 08:50:39 1983

qst de ad7i
red bank, new jersey, u.s.a.
hr arrl bulletin nr 10 from arrl headquarters
newington ct january 28, 1983
to all radio amateurs bt

the fcc has authorized the use of the amtor digital teleprinter code
by radio amateurs in the hf bands. amtor is a handshaking digital
teleprinter technique which is immune to fading, interference and
receiver tuning errors. see june 1981 qst, page 25, for details on
amtor. this fcc action will be effective upon publication in the
federal register ar

-----BEGIN PGP SIGNATURE-----
Version: GnuPG v2.0.19 (FreeBSD)

iEYEARECAAYFAlEOkP4ACgkQ6Pj0az779o6hQwCghW5Rto/6OkyEikksDAqC/pYg
ZgoAn3o2s/WvS99BlB2pzQSnMNme5c7V
=G5UT
-----END PGP SIGNATURE-----
```

9. Ham Radio Now for Monday 25 February 2013

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-02-25 09:07:31 UTC
From: rec-radio-info-request@panix.com
Message-ID: <f46d04479fe19ef75f04d688de12@google.com>
Source record: 139
Cross-posted to: rec.radio.amateur.misc,rec.radio.amateur.digital.misc,rec.radio.info

Ham Radio Now

//
HamRadioNow: Too Much SDR; ARRL@100; On-line Repeater Directory

Posted: 24 Feb 2013 02:43 PM PST
http://hamradionow.tv

HAMRADIONOW EPISODES 59 thru 63: Online Now

59 covers RFinder, a new online repeater directory with apps for iOS and Android, and integration to RP's programming software. My quick tests worked well, but beware the outdated info that plagues all directories.

60 is a talk with ARRL COO Harold Kramer WJ1B on plans for the upcoming Centennial, particularly the National Convention to be held in Hartford in July, 2014.

61 starts the SDR Marathon. We talk to FlexRadio's Greg Jurrens K5GJ. Sure, lots of Flex product info, but also a lot of basic info about what Software Defined Radio is (and isn't).

62 and 63 are from the ARVN Archives, programs previously available only on DVD. Each episode comes in 3 parts of about an hour each.

62 is Phil Harman VK6APH's talk about designing the HPSDR Mercury receiver, the first direct-conversion SDR in Amateur Radio. It was the Sunday Seminar at the 2008 ARRL & TAPR DCC in Chicago. The second one? The Flex 6000 series. They go from antenna to A/D converter with no active components in between (maybe just a bandpass filter).

63 is the SDR Forum from the 2009 Dayton Hamvention®. Six SDR heavyweights cover the future, contesting, Flex, Elecraft, HPSDR, and operating the stuff.

We've got several more interviews to edit from the Orlando HamCation... coming soon, so stay tuned!

10. Ham Radio Now for Tuesday 5 March 2013

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-03-05 09:03:07 UTC
From: rec-radio-info-request@panix.com
Message-ID: <14dae9399ca5a8d68404d729bd41@google.com>
Source record: 140
Cross-posted to: rec.radio.amateur.misc,rec.radio.amateur.digital.misc,rec.radio.info

```
Ham Radio Now

////////////////////////////////////////
HamRadioNow: CQ's W2VU - Will the REAL Ham Radio Please Stand Up

Posted: 04 Mar 2013 06:33 PM PST
http://hamradionow.tv

Episode 64 - All Talk.... not much tech. CQ's editor Rich Moseson W2VU,
HamRadioNow's Gary KN4AQ and Jeff AC4ZO bat around a bunch of current
stuff, from Internet-linked radio (not REAL) radio, to HF digital voice, to
the Chinese radio revolution.
```

11. [tapr-announce] Call for articles

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-03-15 23:44:40 UTC
From: Stan Horzepa <stanzepa@sbcglobal.net>
Message-ID: <5143B159.9080807@sbcglobal.net>
Source record: 141
Cross-posted to: rec.radio.amateur.digital.misc,rec.radio.info

Work on the next issue of TAPR's quarterly newsletter, PSR, is underway
and this is a call for articles for that issue, the Spring -
Pre-Hamvention issue of the newsletter.

The deadline for the next issue of PSR is April 15. Please send your
cards, letters, articles, etc., whatever you have, to wa1lou@tapr.org

73,

WA1LOU - PSR Editor

_____
tapr-announce mailing list

NOTE: This list includes all addresses currently subscribed to any TAPR mailing list.
Please don't try to manually unsubscribe from this list; it won't work. If you unsubscribe
from all other TAPR mailing lists, you will automatically be unsubscribed from this one.

12. 30 Years Ago: Japanese Amateur Radio Satellite JAS-1 Announced

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-03-27 16:20:15 UTC
From: "Paul W. Schleck" <pschleck@oasis.novia.net>
Message-ID: <5152ff9c$0$71764$540ea2cf@novia.net>
Source record: 142
Cross-posted to: rec.radio.amateur.moderated,rec.radio.amateur.digital.misc,rec.radio.amateur.space

-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA1

This is from a web-site that is replaying Usenet, including
net.ham-radio, from 30 years ago (currently early 1983). The site is:

http://www.olduse.net

If you prefer to use your own newsreader, the site also supports an NNTP
connection at:

nntp.olduse.net:119

>From: karn <utzoo!decvax!harpo!eagle!karn>
>Subject: JAS-1 announced
>Newsgroups: net.ham-radio, net.space
>Date: Fri Mar 25 16:24:07 1983

Last weekend, JAMSAT and JARL (the Japanese branch of AMSAT and the
Japanese Amateur Radio League) formally announced a project to build an
amateur radio satellite for launch in 1986 aboard a new Japanese launch
vehicle, the H-1 (similar to the American Delta).

The satellite will physically resemble Oscar-8, and carry two
communications payloads. One will be a Mode J 2m-to-70cm linear
transponder like that on Oscar-8, and the other will be a digital
store-and-forward "mailbox".

The digital half of JAS-1 will be in addition to the similar PACSAT
project being planned in the US for one of three launch possibilities:
aboard a Space Services launcher, a Delta with Landsat D', or aboard the
Landsat 4 Recovery shuttle mission from Vandenburg.

Discussions have been underway between AMSAT and JAMSAT for some time to
establish common modulation, protocols and user interfaces wherever
possible for PACSAT and the digital portion of JAS-1 in order to minimize
user inconvenience.

Launch of JAS-1 is planned for early 1986 into a 1500 km altitude, 50
degree inclination orbit. Note that this orbit will NOT be
sun-synchronous, unlike that planned for PACSAT.

Phil Karn, KA9Q
Asst. VP Engineering, AMSAT

-----BEGIN PGP SIGNATURE-----
Version: GnuPG v2.0.19 (FreeBSD)

```
iEYEARECAAYFAlFS/2sACgkQ6Pj0az779o5jXACgtU3BcWlpcfR0/GVffAEmy0Zh
PUAAoM2i7GrroIhLGDsELePL59BZG2Je
=R/oT
-----END PGP SIGNATURE-----
```

13. Re: 30 Years Ago: Japanese Amateur Radio Satellite JAS-1 Announced

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-03-27 19:13:19 UTC
From: Rob <nomail@example.com>
Message-ID: <slrnkl69ke.g1l.nomail@xs8.xs4all.nl>
Source record: 143
Cross-posted to: rec.radio.amateur.moderated,rec.radio.amateur.digital.misc,rec.radio.amateur.space

Paul W Schleck <pschleck@oasis.novia.net> wrote:
> The satellite will physically resemble Oscar-8, and carry two
> communications payloads. One will be a Mode J 2m-to-70cm linear
> transponder like that on Oscar-8, and the other will be a digital
> store-and-forward "mailbox".

I still have my JAS-1 modem (combined with an early TNC2 clone)
and a printout of a session with the mailbox...

14. [tapr-announce] Second Call for Articles

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-03-28 01:13:08 UTC
From: Stan Horzepa <stanzepa@sbcglobal.net>
Message-ID: <51539832.5030305@sbcglobal.net>
Source record: 144
Cross-posted to: rec.radio.amateur.digital.misc,rec.radio.info

Work on the next issue of TAPR's quarterly newsletter, PSR, is underway
and this is a call for articles for that issue, the Spring -
Pre-Hamvention issue of the newsletter.

The deadline for the next issue of PSR is April 15. Please send your
cards, letters, articles, etc., whatever you have, to wa1lou@tapr.org

73,

WA1LOU - PSR Editor

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tapr-announce mailing list

NOTE: This list includes all addresses currently subscribed to any TAPR mailing list.
Please don't try to manually unsubscribe from this list; it won't work. If you unsubscribe
from all other TAPR mailing lists, you will automatically be unsubscribed from this one.

15. 30 Years Ago: AX.25 Level 2 Protocol

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-03-30 22:05:51 UTC
From: "Paul W. Schleck" <pschleck@oasis.novia.net>
Message-ID: <5156967b$0$71800$540ea2cf@novia.net>
Source record: 145
Cross-posted to: rec.radio.amateur.moderated,rec.radio.amateur.digital.misc

-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA1

This is from a web-site that is replaying Usenet, including
net.ham-radio, from 30 years ago (currently early 1983). The site is:

http://www.olduse.net

If you prefer to use your own newsreader, the site also supports an NNTP
connection at:

nntp.olduse.net:119

>From: dna <utzoo!decvax!decwrl!sun!megatest!fortune!dsd!dna>
>Subject: AX.25 Level 2 Protocol
>Newsgroups: net.ham-radio
>Date: Mon Mar 28 18:14:03 1983

AX.25 LEVEL 2 PROTOCOL

Terry Fox, WB4JFI
Vice-President, AMRAD
1819 Anderson Road
Falls Church, VA 22043

Abstract

This paper contains the latest draft of the
AX.25 protocol specification. This is the first
public release of this draft. Earlier drafts have
been given to specific inviduals for comment and
as a reference for software development. Changes
should be expected. Please check the AMRAD
Newsletter for announcements of later versions.

History

Over the years there have been several proto-
cols suggested for use at layer 2 of the ISO Open
System Interface Reference Model (OSI-RM) over
Amateur Radio. The one system that has been in
use is based on the IBM SDLC protocol, and it has
been working as far as it went. One of the imme-
diate problems that came up with SDLC was that
its address field of SDLC is very limited (being
one byte long), causing problems if there are many
amateurs on at a time.

Trying to come up with a protocol that everyone would agree to seemed like an almost impossible task a year ago. What we at AMRAD decided to do was to go over the various protocols in use or available to the amateur, figure out the best and worst parts of each protocol and see if the protocol could be "enhanced" to work properly over the amateur radio enviroment. After reviewing the various protocols around and talking with people in the computer networking industry, we decided to push the X.25 standard, modified to allow a larger address field. At about this time, a group of amateurs in New Jersey were coming to the same conclusion, so about mid-June of 1982 the two groups got together and after two weekends came to an "understanding" on a level 2 protocol. The most delicate part of the negotiations between the two groups concerned the name to be given this protocol. In order to not step on anyones toes, it was decided to call the protocol AX.25, which stands for Amateur X.25.

The next step in the evolvement of AX.25 was that in October of 1982, AMSAT hosted a gathering of some of the leaders in amateur packet radio. AMRAD was at the meeting, along with representatives from TAPR, SLAPR, AMSAT, and PPRS. Three days of intense discussion followed, and an agreement was finally reached on a nation-wide compatible protocol. AX.25 was then modified to be compatible with this new protocol (basically the only major changes were an additional extension of the address field, and the addition of a Protocol IDentifier, or PID field).

The rest of this paper will describe the basics of the AX.25 level 2 protocol.

AX.25 Layer 2 Protocol Specifcation

This protocol conforms with the ISO Recommendations 3309, 4335 (including DAD 1&2) and 6256 high-level data link control (HDLC) and uses some terminology found in these documents.

This protocol also conforms with ANSI X3.66, describing ADCCP, balanced mode.

This protocol is written to work equally well in either half- or full-duplex amateur radio enviroments.

This protocol has been written to work equal-
ly well for either point-to-point connections, or
connections made thru a larger device, such as a
metropolitan network controller (MNC).

This protocol does allow the establishment of
more than one layer 2 (link layer) connection per
device, if the device is so capable.

This protocol also follows in principle the
CCITT X.25 recommendation, with the exception of
an extended address field and the addition of the
Unnumbered Information (UI) frame.

Most layer 2 protocols assume that one large
device (generally called a DCE, or data circuit-
terminating equipment) is connected to several
smaller devices (usually called a DTE, or data
terminating equipment). AX.25 assumes that both
ends of the link are balanced, thereby eliminating
the two different classes of device.

Frame_Structure

Level 2 packet-radio transmissions are sent
in small blocks, called frames. These frames are
made up of smaller parts, called fields. Fig. 1
shows how the three types of frames are made up.
Fig. 1 shows the frames in the same bit order that
most packet articles show them. Unfortunately,
this method has led to some confusion, since the
least-significant bit (LSB) is to the left rather
than to the right, as most people would ordinarily
assume. I am pointing this out early in this
paper to prevent mass confusion as I progress.
Later on, I will switch to a hopefully more under
standable way of showing the frame ans its compo
nents.

Field_Definitions

The frame is made up of several parts, called
fields. Each of these fields is made up of an
integral number of octets (or bytes), and serves a
specific function.

Flag_Field

Since amateur packet radio is a bit-oriented
protocol, the only way to tell when one frame is
over and another is starting for sure is to
delimit each frame with a certain bit sequence
both at the beginning and the end. This is the
job of the flag field. A flag consists of a zero

followed by six ones followed by another zero, or 01111110 (7E hex). Due to the bit stuffing mentioned above, the only time this sequence is allowed is at the beginning and end of a legitimate frame.

Address_Field

The address field is used to identify both where the frame came from and what the destination of it is. In the CCITT recommendation X.25, this field is only one octet long. This permits at most 256 users per level 2 channel, and since some bits of this field were used for other purposes, the real number of users were about thirty per level 2 channel. Both the HDLC and ADCCP recommendations allowed the address field to be extended, so we decided to extend the address field per their recommendations in the amateur version of X.25 to include the callsigns of both the destination and source amateur radio stations.

The method used to extend the address field will be described shortly.

Control_Field

The control field is used to identify the type of frame and control several attributes of the level 2 connection. It is one octet in length, and its encoding will be discussed in a following section.

PID-Field

The Protocol Identifier (PID) field is used only in information frames, and identifies what kind of layer 3 protocol, if any, is in use. Its encoding is as follows:

M L
S S
B B
xx00xxxx Reserved at the moment.
xx01yyyy AX.25 layer 3 implemented.
xx10yyyy AX.25 layer 3 implemented.
11110000 No layer 3 implemented.
11111111 Escape character. Next byte contains more PID information.

Where:

1. An x indicates a "don't care" bit.
2. A y indicates all combinations used.

Information_Field

The information field is used to convey the actual user data from one end of the link to the other. I fields are allowed in only three tyes of frames, the I frame, the UI frame, and the FRMR frame. The I field can be up to 256 octets long, and should be an even multiple of octets long. Any information in the I field should be passed along the link totally transparently, except for any zero-bit insertion necessary to prevent flags from accidentally appearing in the I field.

Frame_Check_Sequence

The frame-check sequence is a sixteen-bit number calculated by both the sender and receiver of a frame. It is used to make sure that the frame was not corrupted by the medium used to get the frame from the sender to the receiver. It is calculated in accordance with ISO 3309 (HDLC) recommendations.

Bit_Stuffing

In order to assure that the flag sequence mentioned above doesn't accidentially appear any where else in a frame, as the frame is being sent it should be monitored, and if more than five contiguous ones are detected, a zero bit should be added between the fifth and sixth ones, eliminating the possibility of a flag appearing in the frame other than where it belongs. The receiver of five ones, a zero, and more ones should automatically eliminate the inserted zero before passing the data on.

Bit_Order_of_Transmission

With the exception of the FCS field, all other fields in an AX.25 frame should be sent starting with the least-significant bit. In accordance with HDLC practices, the FCS should be sent most-significant bit first.

Frame_Abort

If a frame must be prematurely aborted, at least fifteen contiguous ones should be sent with no bit stuffing added.

Invalid_Frames

Any frame consisting of less than 136 bits, or not bounded by opening and closing flags, or not octet aligned (an integral number of octets) should be considered an invalid frame by the link layer.

Address_Field_Encoding

The address field of all frames should be encoded with both the destination and source amateur callsigns of the frame. If a level 2 amateur "repeater" is to be used, its callsign should also be in the address field. AX.25 follows the HDLC recommended method of extending the address field in order to fit all this information into the address field.

Basically, the way the HDLC address field is extended beyond one octet is to reserve the least-significant bit of each octet for what is called an "extender bit". This bit is set to zero if the next octet contains more address field information, and is set to one if this is the last octet. To make room for this extender bit, the amateur radio call sign information is shifted one bit to the left.

The actual encoding techniques for both non-repeater and repeater operation follows.

Non-Repeater_Address-Field_Encoding

If a level 2 repeater is not being used, the address field is encoded as shown in Fig. 2. The destination address is the call sign of the amateur radio station that the frame is addressed to, while the source address contains the amateur call sign who sent the frame. These call signs are the call signs of the two ends of a level 2 AX.25 link only, not of any other station, such as the destination of a packet going thru an intermediary link. Those addresses should be in a higher layer, not layer 2.

A1 thru A14 are the fourteen octets that make up the two address sub-fields of the address field. The destination sub-address is seven octets long (A1 thru A7), and is sent first. This will allow the receivers of the frame time to check the destination address sub-field and see if the frame is for them while the rest of the frame is being received. The source address sub-field is then sent in octets A8 thru A14. Both of these

sub-fields are encoded in the same manner, except for the last octet having the HDLC address extender bit set. Since they are basically the same, only the destination sub-address will be outlined.

There is an extra octet at the end of each address sub-field that allows room for a Secondary-Station Identifier (SSID) and three additional bits for future expansion. The SSID field allows an Amateur Radio operator to have more than one packet radio station. This is useful when an amateur wants to put up a repeater in addition to his regular station for example.

Appendix A shows a typical AX.25 frame in the non-repeater mode.

Destination Sub-Field Encoding

Fig. 3 shows how an amateur call sign is placed in the destination address sub-field, occupying octets A1 thru A7.

Octet	ASCII	Bin.Data	Hex Data
A1	W	10101110	AE
A2	B	10000100	84
A3	4	01101000	68
A4	J	10010100	94
A5	F	10001100	8C
A6	I	10010010	92
A7	SSID	0RRSSID0	

Bit Position--> 76543210

Fig. 3. Destination Field Encoding

Where:

1. The top octet (A1) is the first octet sent (sort of like popping it off the top of the stack), with bit 0 of each octet being the first bit sent, and bit 7 being the last bit sent.

2. The first (low order or bit 0) bit of each octet is the HDLC extender bit, which is set to zero on all but the last octet in the address field, where it is set to one.

3. The bits marked "R" are reserved bits.
they may be used in an agreed upon
manner in individual networks. If they
aren't implemented, they should be set
to one.

4. The characters of the callsign should be
standard seven-bit ASCII (upper case
only) before being shifted left to make
room for the extender bit. If the
callsign is less than six characters
long, it should be padded at the
trailing end with ASCII spaces between
the end of the callsign and the SSID
octet.

5. The SSID portion of the last octet has
been intentionally left vague at this
point, and is left up to the individual
station to assign. The only recommended
restriction is to reserve the all-one
condition (1111) for an all-call SSID in
case one wants to reach an amateur but
dooesn't know what SSID that amateur
operates under.

Level_2_Repeater_Address-Field_Encoding

If a frame is to go thru a level 2 amateur
packet repeater, there is an additional address
sub-field added to the end of the address field.
This additional sub-field contains the call sign
of the repeater to be used. This will allow more
than one repeater to share the same rf channel,
which has been a problem with the older protocols.
If this field exists, the last octet of the source
sub-field has its extender bit set to zero, indi-
cating that more address-field data follows. The
repeater address sub-field is encoded in the same
manner as the destination and source address sub-
fields, except for one bit in the last octet,
called the "H" bit. The H bit is used to indicate
whether a frame has been repeated or not. This is
necessary to prevent someone from potentially
receiving two identical frames, the one going to
the repeater, and the one coming back from the
repeater. Fig. 4 shows how the repeater address
sub-field is encoded. Appendix B is an example of
a complete frame on its way back from a repeater.

```
-----------------------------------
| Octet | ASCII |Bin.Data|Hex Data|
|---------------------------------|
```

```
| A15 | W |10101110| AE |
| A16 | B |10000100| 84 |
| A17 | 4 |01101000| 68 |
| A18 | J |10010100| 94 |
| A19 | F |10001100| 8C |
| A20 | I |10010010| 92 |
| A21 | SSID |HRRSSID1| |
-----------------------------------
Bit Order --> 76543210
```

Fig 4. Repeater Address Encoding

Where:

1. The top octet is the first octet sent, with bit 0 being sent first, bit 7 sent last of each octet.

2. As with the source and destination address sub-fields discussed above, bit 0 of each octet is the HDLC address extender bit, which is set to zero on all but the last address octet (A21) where it is set to one.

3. The "R" bits are reserved just like in the source and destination sub-fields.

4. The "H" bit is the has-been-repeated bit. It is set to zero on a non-repeated frame, and set to one by the repeater when the frame has been repeated.

It should be noted that some of the advantages of this addressing scheme are mentioned in Appendix C.

Control_Field_Formats

The control field is responsible for identifying what type of frame is being sent, and is also used to convey commands and responses from one end of the link to the other to maintain proper control over the link.

The control fields used in AX.25 use the CCITT X.25 control fields for balanced operation, with an additional control field taken from ADCCP to allow connectionless and round-table operation.

There are three general types of AX.25 frames. They are the Information frame (I frame), the Supervisory frame (S frame), and the Unnum-

bered frame (U frame). Fig. 5 shows the basic format of the control field associated with these types of frames.

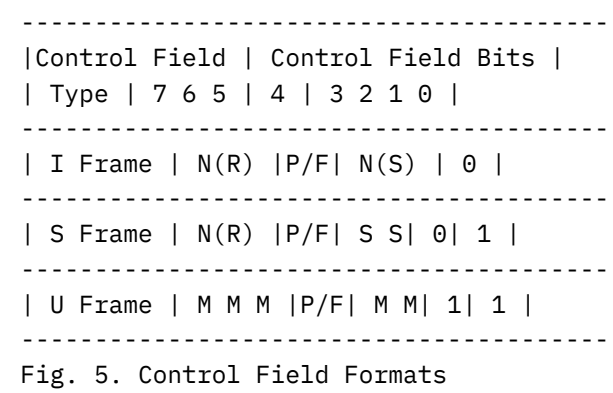

Fig. 5. Control Field Formats

Where:

1. Bit 0 is the first bit sent, bit 7 is the last bit sent of the control field.

2. N(S) is the send sequence number (bit 2 is the LSB).

3. N(R) is the receive sequence number (bit 6 is the LSB).

4. The "S" bits are the supervisory function bits, and their encoding is discussed below.

5. The "M" bits are the unnumbered frame modifier bits and their encoding is discussed below.

6. The P/F bit is the Poll/Final bit. Its function is described in more detail shortly.

Control_Field_Definitions

Information Frame Control Field

All I frames have bit 0 of the control field set to zero. N(S) is the sender's send sequence number (the send sequence number of this frame). N(R) is the sender's receive sequence number (the sequence number of the next expected received frame. These numbers are described in the section regarding flow control.

Supervisory Frame Control Field

Supervisory frames are denoted by having bit 0 of the control field set to one, and bit 1 of the control field set to zero. S frames provide supervisory link control such as acknowledging or requesting retransmission of I frames, and link level window control. Since S frames don't have an information field, the sender's send variable and the receiver's receive variable are not incremented for S frames.

Unnumbered Frame Control Field

Unnumbered frames are distinguished by having both bits 0 and 1 set to one. U frames are responsible for maintaining control over the link beyond what is accomplished with S frames. They are also responsible for the establishment and tearing down of the link. U frames also allow for the transmission and reception of information outside of the normal flow control. Some U frames may contain information fields.

Control_Field_Parameters

Sequence_Numbers_and_Variables

Every AX.25 I frame shall be assigned a sequential number from 0 to 7. This will allow up to seven outstanding I frames per level 2 connection at a time.

Send_State_Variable_V(S)

The send state variable is an internal variable that is never sent. It contains the next sequential number to be assigned to the next transmitted I frame. This variable is updated upon the transmission of each I frame.

Send_Sequence_Number_N(S)

The send sequence number is found in the control field of all I frames. It contains the sequence number of the I frame being sent. Just prior to the transmission of the I frame, N(S) is updated to equal the send state state variable.

Receive_State_Variable_V(R)

The receive state variable is an internal variable that contains the sequence number of the next expected received I frame. This variable is updated upon the reception of an error-free I frame whose send sequence number equals the present received state variable value.

Received_Sequence_Number_N(R)

The received sequence number is in both
I and S frames. Prior to sending an I or S frame,
this variable is updated to equal that of the
received state variable, thus implictly acknow-
ledging the proper reception of all I frames up to
and including N(R)-1.

Poll/Final_(P/F)_Bit

The P/F bit may be used in all types of
frames. It is used in a command (poll) mode to
request an immediate reply to a frame. The reply
to this poll is indicated by setting the response
(final) bit in the appropriate frame. Only one
outstanding poll condition per direction is al-
lowed at a time.

Control_Field_Encoding

Information_Frame_Control_Field

The information frame control field is
encoded as shown in Fig. 6. These frames are
sequentially numbered to maintain control of their
passage over the link level connection.

```
Control Field Bits
-------------------------
| 7 6 5 | 4 | 3 2 1 | 0 |
-------------------------
| N(R) |P/F| N(S) | 0 |
-------------------------
```

Fig. 6. I Frame Control Field

Supervisory_Frame_Control_Field

The supervisory frame control fields are
encoded as shown in Fig. 7. In AX.25, S frames
are used only as responses to other frames.

```
-----------------------------------------------
| Control Field Bits | 7 6 5 | 4 | 3 2 | 1 0 |
|---------------------------------------------|
| Receive Ready RR | N(R) |P/F| 0 0 | 0 1 |
|Receive Not Ready RNR | N(R) |P/F| 0 1 | 0 1 |
| Reject REJ | N(R) |P/F| 1 0 | 0 1 |
-----------------------------------------------
```

Fig. 7. S frame control Fields

Receive_Ready_(RR)_Response

Receive Ready is used to do the fol
lowing:

1. To indicate that the sender of the RR is
now able to recieve more I frames.

2. To acknowledge properly received I
frames up to, and including N(R)-1.

3. To clear a previously set busy condition
created by an RNR command having been
sent.

It should be noted that the status of
the other side of the link can be requested by
setting the poll bit.

Receive_Not_Ready_(RNR)_Response

Receive not ready is used to indicate to
the sender of I frames that receiver is temporari-
ly busy and cannot accept any more I frames.
Frames up to N(R)-1 are acknowledged. Any I frames
numbered N(R) and higher that might have been
caught in between and not acknowledged when the
RNR command was sent are NOT acknowledged.

The RNR condition can be cleared by the
sending of a UA, RR, REJ, or SABM frame. The P/F
bit can be used within the RNR frame to interro-
gate the status of the other side of the link.

Reject_(REJ)_Response

The reject frame is used to request
retransmission of I frames starting with N(R).
Any frames that were sent with a sequence number
of N(R)-1 or less are acknowledged. Additional I
frames may be appended to the retransmission of
the N(R) frame if there are any.

Only one reject frame condition is al-
lowed in each direction at a time. The reject
condition is cleared by the proper reception of I
frames up to the I frame that caused the reject
condition to be initiated.

As with the other supervisory responses,
the P/F bit may be used in the REJ frame.

Unnumbered_Type_Frames

Unnumbered frame control fields are
either commands or responses. This standard fol-
lows X.25 as much as possible. The only deviation
from X.25 is in the addition of the Unnumbered
Information (UI) frame from ADCCP. X.25 is de-
signed to work with in full-duplex systems with

only one main device (DCE) and potentially many users (DTEs).

Amateur Radio packet systems differ greatly on both of these respects. Not only is Amateur Radio packet networking done in a half-duplex rf environment, but many DCE/DTE links many be sharing the same channel. Many amateurs have rejected the use of X.25 as a result of these problems. X.25 can easily be enhanced so that it will perform properly over amateur radio.

Fig. 8 shows the layout of U frames implemented within this standard.

Control Field	Type	Control Field Bits							
		7	6	5	4	3	2	1	0
Set Asynchronous Balanced Mode-SABM	Cmd	0	0	1	P	1	1	1	1
Disconnect-DISC	Cmd	0	1	0	P	0	0	1	1
Disconnected Mode DM	Res	0	0	0	P/F	1	1	1	1
Unnumbered Acknowledge-UA	Res	0	1	1	F	0	0	1	1
Frame Reject-FRMR	Res	1	0	0	F	0	1	1	1
Unnumbered Information-UI	Either	0	0	0	P/F	0	0	1	1

Fig. 8. U Frame Control Fields

Set_Asynchronous_Balanced_Mode_(SABM)_Command

The SABM command is used to place 2 stations in the asynchronous balanced mode. This is a balanced mode of operation known as LAP B where DCEs and DTEs are treated as equals.

Information fields aren't allowed in SABM commands. Any outstanding I frames left when the SABM command is issued will remain unacknowledged.

Disconnect_(DISC)_Command

The DISC command is used to terminate a link session between two stations. No information

field is permitted in a DISC command frame. Any outstanding I frames will remain outstanding.

Disconnected_Mode_(DM)_Response

The disconnected mode response is sent whenever the DTE or DCE receives a frame other than a SABM while in a disconnected mode. It is sent to request a set mode command, or to indicate it cannot accept a connection at the moment. The DM response cannot have an information field.

A DCE or DTE in the disconnected mode will respond to any command other than a SABM with a DM response with the P/F bit set to 1.

Unnumbered_Acknowledge_(UA)_Response

The UA response frame is sent to acknowledge the reception and acceptance of a U frame command. A received command is not actually processed until the UA response frame is sent. An information field is not permitted in a UA frame.

Frame_Reject_(FRMR)_Response

The FRMR response frame is sent to report that for some reason the receiver of a command or information frame cannot successfully process that frame and that the error condition is not correctable by sending the offending frame again. Typically this condition will appear when a frame without an FCS error has been received with one of the following conditions:

1. The reception of an invalid or not implemented command or response frame.

2. The reception of an I frame whose information field exceeds the agreed upon length.

3. The reception of an improper N(R). This usually happens when the N(R) frame has already been sent and acknowldeged, or when N(R) is out of sequence with what was expected.

4. The reception of a frame with an information field where one is not allowed, or the reception of an U or S frame whose length is incorrect.

When a CMDR or FRMR frame is sent, an information field is added to the frame that helps to explain where the problem occurred. This information field is three octets long and its contents is shown if Fig. 9 below.

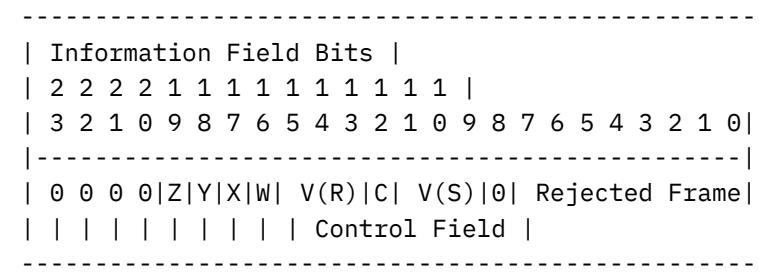

Fig. 9. FRMR Frame Information Field

Where:

1. The rejected frame control field carries the control field of the frame that caused the reject condition. It is in bits 1-8 of the information field.

2. V(S) is the current send state variable of the device reporting the rejection (bit 10 is the low bit).

3. V(R) is the current receive state variable of the device reporting rejection (bit 14 is the low bit).

4. If W is set to 1, the control field received was invalid or not implemented.

5. If X is set to 1, the frame that caused the reject condition was considered invalid because it was a U or S frame that had an information field that is not allowed. Bit W must be set to 1 in addition to the X bit.

6. If Y is set to 1, the information field of a received frame exceeded the maximum capacity of the device reporting the condition.

7. If Z is set to 1, the control field received and returned in bits 1 to 8 contained an invalid N(R).

8. Bits 8, and 20 to 23 are set to 0. Bit 12 is set to 0 if the rejected frame was a command, or 1 if if it was a response.

Unnumbered_Information_(UI)_Frame

The unnumbered information frame is used to pass information along the link outside the normal information controls. This allows information fields to go back and forth on the link bypassing flow control. Since these frames are NOT acknowledgeable, if one gets wiped out, there is no way to recover it.

The UI frame is not defined in X.25. It has been taken from ADCCP to allow uncontrolled information to flow thru the link without interfering with a next higher layer.

Link_Error_Recovery

There are several link-level errors that are recoverable without tearing down the connection. These error situations may occur as a result of malfunctions within the DTE or DCE, or if transmission errors occur.

Invalid_Frame_or_FCS_Error

If an invalid frame is received, or a frame is received with an FCS error, that frame will be discarded with no action taken.

Device_Busy_Condition

When a DTE or DCE becomes temporarily busy, such as when receive buffers are full, it will send a receive not ready (RNR) frame. This tells the other side of the link that the device cannot handle any more I frames at the moment. This condition is usually cleared by the sending of a UA, RR, REJ, or SABM command frame.

Send_Sequence_Number_Error

If the send sequence number , N(S), of an otherwise error-free received I frame does not match the receive state variable, V(R), a send sequence error has occured, and the information field will be discarded. The receiver will not acknowledge this frame, or any other I frames until N(S) matches V(R).

The control field of the erroneous I frame(s) will be accepted so that link supervisory functions can still be performed, such as checking the P/F bit. Because of this updating, the retransmitted I frame may have an updated P bit and N(R).

Reject_(REJ)_Error_Recovery

REJ is used to request a retransmission of I frames following the detection of a sequence error. Only one outstanding reject condition is allowed at a time. This condition is cleared when the requested I frame has been received.

A device receiving the REJ command will clear the error by sending over the I frame indicated in N(R) of of the REJ command frame.

Time-out_Error_Recovery

When a transmission abnormality wipes out a single I frame, or the last I frame of a group, there is no way of telling this immediately, since the receiver does not necessarily know something was sent until another frame is sent resulting in an out-of-sequence error. To cope with this situation better, some form of time-out delay will be incorporated by the sender after it sends out a frame. This time-out timer is started at the time a frame is sent, and stopped by the reception of an acknowledgement for the sent frame. If the timer times out before an acknowledgement is received, any unacknowledged frames are retransmitted. The delay is an agreed-upon amount that will vary with the type of rf medium and signaling speed used.

Rejection_Error

A rejection error condition occurs when an error-free received frame has one of the following problems:

1. An invalid command or response control field.

2. An invalid frame format.

3. An Invalid N(R).

4. An information field that exceeds the maximum the device can accept.

Once a rejection error occurs, no more I frames are accepted (with the exception of the P/F bit still usable) until the error is resolved. The error condition is reported to the other side of the link by sending a FRMR response frame.

Primary/Secondary_versus_Balanced_Operation

There are two basic classes of link-level connections. The first, known as Link Access Procedure (or LAP) is often called an unbalanced service where the DCE is considered the primary (or master) devices and the DTEs are considered secondary (or slave) devices. The second class of service is known as LAPB, Link Access Procedure Balanced. In this service both devices are treated as equals as far as connection requests and other types of commands. There is still only one DCE and potentially many DTEs, but both ends can command the link equally.

Primary/Secondary_(LAP)_Operation

LAP is the older style of link control, where most of the intelligence was assumed to be in a large mainframe (the DCE) and the end users were just using smart terminals (the DTEs). Since network software can have a lot of overhead, it made sense at the time to put most of the overhead in the big computer, and just enough smarts to make the link work in the terminals.

Balanced_(LAPB)_Operation

LAPB is a slightly modified version of LAP. It has been changed to allow the two sides of a link to operate in a more balanced manner. In the official version of X.25 there is still only one DCE to potentially many DTEs, but the two can operate more as equals than master and slave.

LAPB is what this document describes for use over Amateur Radio packet networks. Even when there is a network controller overseeing the network operation, the balanced link procedure will enhance operation.

Connection_Operation

In amateur radio network operations, it would be very helpful if one level 2 protocol would work with the various rf systems in use. An example of this is the difference in operation between a simple two-station link, and multiple stations operating thru a network controller. Obviously, when a network controller exists, it should be considered the DCE, while the other stations connecting to it would be the DTEs. A simple two-station connection is another matter. To this type of connection the station requesting a connection should always be considered the DTE,

while the device that is receiving the connection request should operate as the DCE. This simple rule should eliminate any ambiguity that might otherwise occur under these conditions.

NOTE There are a couple minor changes from the official X.25 standard in the protocol recommended here. These changes are done only as absolutely necessary to work over the shared rf media. Since X.25 was written to work so that one DCE talked with many DTEs over a closed network, it cannot properly cope with a channel where there may be many DCEs linked to many DTEs. Some amateurs have thrown X.25 out because of this problem. It seems to take just a couple minor changes in the initial link set-up procedure to make X.25 work properly over amateur radio. Where these changes are made, both the original X.25 procedure and the recommended amateur procedure will be noted.

LAPB_Procedures

The following describes the procedures used to set-up, use, and disconnect a balanced link between a DTE and DCE. These procedures have been taken from X.25 and conform very closely to that standard, except where it was necessary to change due to the radio enviroment.

Address_Field_Operation

All transmitted frames shall have address fields conforming to above-mentioned rules. All frames should have both the destination device and the source device addresses in the address field, with the destination address coming first. This will allow many links to share the same rf channel. The destination address is always the address of the station(s) to receive the frame, while the source address contains the address of the dveice that sent the frame. The destination address can be a group name or club call however, if point to multi-point operation is allowed. This will be discussed further under link operations.

LAPB_Connection_Establishment

When a device (either a DCE or DTE) wishes to connect to another device, it will send a SABM command frame to that device and start a

time-out timer (T1). If the other device is there and able to connect, it will answer with a UA response frame and at the same time reset both of it's internal state variables (V(S) and V(R)). The reception of the UA response frame at the other end will cause the device requesting the connection to abort the T1 timer and set its internal state variables to 0 also.

If the other device doesn't respond before T1 times out, the device requesting the connection will re-send the SABM frame, and start T1 running again. This trying to establish a connection will continue until the requesting device has tried unsuccessfully a number of times. That number (N1) is variable, depending on the frequency of operation, type of transmission (eg. terrestial vs. satellite), and the signaling speed in use. N1 will be discussed in another section.

Information_Transfer

Once a connection has been established as outlined above, both devices are able to accept I, S, and U frames.

Sending_of_I_Frames

Whenever a station has an I frame to transmit, it will send the I frame with N(S) of the control field equal to it's current send state variable V(S). Once the I frame is sent, the send state variable is incremented by one.

The station should not transmit any more I frames if it's send state variable equals the last received N(R) from the other side of the link plus seven. If it were to send more I frames, the flow control window would be exceeded and errors could result.

If a device is in a busy condition, it may still send I frames as long as the other device is not also busy.

If a device is in the frame-rejection mode, it will stop sending I frames.

Receiving_I_Frames

If a device receives a valid I frame (one with a correct FCS and whose send sequence number equals the receiver's receive state varia-

ble) and is not in the busy condition, it will accept the received I frame, increment it's receive state variable, and act in one of the following manner:

1. If it has an I frame to send, that I frame may be sent with the transmitted N(R) equal to it's receive state variable V(R) (thus acknowledging the received frame. Alternately, the device may send an RR frame with N(R) equal to V(R), and then send the I frame.

2. If there are no outstanding I frames, the receiving device will send an RR frame with N(R) equal to V(R).

If the device is in a busy condition, it may ignore any received I frames without reporting this condition other than repeating the indication of the busy condition.

If a busy condition exists, the station receiving the busy condition indication should poll the sender of the busy indication periodically until the busy condition disappears.

The reception of I frames that contain zero length information fields shall be reported to the next level but no information field will be transferred.

When an I frame is received with a correct FCS, but it's send sequence number does not match the current receiver's receive state variable, the frame should be discarded and a REJ frame should be sent with a receive sequence number equal to one higher (modulo 8) than the last correctly received I frame . Any out-of-sequence received I frames should be handled in this manner. The received state variable and poll bit in such a discarded frame should be checked before throwing it away, and take any action needed depending on the condition of them.

Receiving_Acknowledgement

Whenever an I or S frame is correctly received, even in a busy condition, the N(R) of the received frame should be checked to see if it includes an acknowldegment of outstanding sent I frames. The T1 timer should be reset if the received frame actually acknowledges previously

unacknowledged frames. If the T1 timer is reset, and there are still some frames that have been sent that are not acknowledged, T1 should be started again. If the T1 timer runs out before an acknowledgement is received, the device should proceed to the retransmission procedure.

Receiving_Reject

Upon receiving a REJ frame, the transmitting station will set its send state variable to the same value are the REJ frames received sequence number in the control field. The device will then retransmit any I frame(s) outstanding at the next available opportunity conforming to the following:

1. If the device is not transmitting at the time, and the channel is open, the device may commence to retransmit the I frame(s) immediately.

2. If the device is operating on a full duplex channel transmittiong a U or S frame when it receives a REJ frame, it may finish sending the U or S frame and then retransmit the I frame(s).

3. If the device is operating in a full duplex channel transmitting another I frame when it receives a REJ frame, it may abort the I frame it was sending and start retransmission of the requested I frames immediately.

4. The device may send just the one I frame outstanding, or it may send more than one if any more I frames followed the first one not acknowledged, provided the total to be sent does not exceed the flow control window (7 frames).

If the device recives a REJ frame with the poll bit set, it should respond with either an RR or RNR frame with the final bit set before retransmitting the outstanding I frame(s).

Receiving_an_RNR_Frame

Whenever a device receives an RNR frame, it may transmit or retransmit the I frame whose send sequence number equals that of the received sequence number indicated in the RNR control field. If timer T1 runs out after the RNR was

received, the waiting acknowledgement procedure listed below should be performed. The poll bit may be used in conjunction with S frames to test for a change in the condition of the busied out station. No I frames other than the one mentioned above may be sent out before the busy condition is cleared.

Sending_a_Busy_Indication

Whenever a device enters a busy condition, it will indicate this by sending an RNR response at the next opportunity. While the device is in the busy condition, it may receive and process S frames, and if a received S frame has the P bit set to one, the device should send a RNR frame with the F bit set to one at the next possible opportunity. To clear the busy condition, the device should send either a RR or REJ frame with the received sequence number equal to the current receive state variable, depending on whether the last received I frame was properly received or not.

Waiting_Acknowledgement

The device should maintain an internal retransmission count variable which is set to zero whenever another I frame is acknowledged (either thru the reception of a UA or RNR frame, or when a received I or S frame has an N(R) higher than the last received N(R), showing the acknowledgement of additional I frames).

Any time the timer T1 runs out, the device will re-enter the timer recovery condition, the retransmission count variable will be incremented by one, and another internal variable (X) will be set to the current send state variable value.

The device will then restart the T1 timer, set its receive state variable to the last receive sequence number, and retransmit the corresponding I or S frame with the P bit set to one.

The timer recovery condition is cleared when the device receives a valid S frame with the F bit set to one.

If the device receives an S frame with the F bit set to one and N(R) within the range from the current send state variable to X men-

tioned above inclusive while in the timer recovery condition, this condition will be cleared, and the send state variable will be set to the N(R) received.

If the device receives an S frame with the F bit set to zero but otherwise the same condition as the last paragraph, the timer recovery condition will NOT be cleared. The received N(R) may be used however to update the send state variable. The device may keep the last I frame transmitted (even if it was acknowledged) to be retransmitted with the P bit set to one if timer T1 expires at a later time.

Once the retransmission count variable reaches N2, the device should proceed to the resetting procedures outlined below.

Link_Disconnection

When in the information-transfer phase, either device may initiate a link disconnection by sending a DISC frame. It should then start its T1 timer, and wait for a response. If the proper response doesn't come before T1 times out, it should send the DISC frame again and restart T1. If this happens N2 times, the device should enter the disconnected state.

When a DISC frame is received, the receiver should return a UA response frame, and enter the disconnected state.

Disconnected_State

After having sent a DISC frame and received a UA, or receiving a DISC and having sent a UA, the device will enter the disconnected state.

In the disconnected state, the device may initiate a link set-up as outlined in connection establishment above. It may also respond to the reception of a SABM and establish a connection, or it may ignore the SABM and send a DM instead.

Any station receiving a DISC command while in the disconnected state should send back a DM response frame.

Any device receiving a command frame other than a SABM or UI frame with the P bit set to one should respond with a DM frame with the F bit set to one. The offending frame should also be ignored.

When the device enters the disconnected state after an error condition or if it has recovered from an internal error condition by coming up in the disconnected state, it should indicate this by sending a DM response rather than a DISC frame. It should start the T1 timer when the DM is sent, and if T1 times out before getting a SABM or DISC frame back, it should send another DM frame, and restart T1. After retransmitting the DM frame N2 times, the device will remain in the disconnected state, and no other action will be taken.

Resetting_Procedure

The resetting procedure is used to initialize both directions of flow after a non-recoverable error has occured. This resetting procedure is only used when in the information transfer phase of an AX.25 link.

A device shall request a reset by sending an SABM frame. Upon receiving an SABM frame from a station previously connected to, the receiver of an SABM frame should send a UA frame back at the earliest opportunity. Both devices should then set their send and receive state variables to zero. Any busy condition that previously existed will also be cleared.

It is possible to initiate a disconnect procedure instead of resetting the link.

One device may ask the other to reset the link by sending a DM response frame. After the DM frame is sent, the sending device will then enter the disconnected state.

One device may ask the other to initiate a link reset by transmitting a FRMR response frame.

After sending the FRMR frame, The sending device will enter the frame reject state. This condition is cleared when the device that sent the FRMR frame receives an SABM or DISC command, or a DM response frame. Any other command received while the device is in the frame

reject state will cause another FRMR to be sent out with the same information field as originally sent.

The device that sent the FRMR frame should start the T1 timer when the FRMR is sent. If above mentioned frames are not received before the timer runs out, the FRMR frame should be retransmitted, and the T1 timer restarted as described in the waiting acknowledgement section above. If the FRMR is sent N2 times without success, the link should be reset.

Rejection_Conditions

A device should initiate the link-reset procedure when a frame is received with the correct FCS and address field during the information transfer phase with one or more of the following conditions:

1. The frame is not known as a command or response to the device.

2. The information field is invalid (as an example is longer than 256 octets).

A device will initiate a reset procedure whenever it receives a DM or FRMR response frame during the information transfer phase.

A device may initiate a reset procedure also whenever it receives a UA response frame or if it receives an unsolicited response frame with the F bit set to one.

Collision_Recovery

Collisions_in_a_Half-Duplex_Enviroment

Collisions of frames of any type in a half-duplex enviroment are essentially taken care of by the retry nature of the T1 timer and retransmission count variable. No other special action needs to be taken.

Collisions_in_a_Full-Duplex_Enviroment

Collisions in a full-duplex enviroment are not really frame collisions, but have more to do with the devices being pulled in two different directions at the same time.

Collisions_of_Unnumbered_Commands

If the sent and received U command frames are the same, both devices should send a UA response at the earliest opportunity, and both devices should enter the indicates state.

If the sent and received U commands are different, both devices should enter the disconnected state, and transmit a DM frame at the earliest opportunity.

Collision_of_a_DM_with_a_SABM_or_DISC

When an unsolicited DM response frame is sent, a collision between it and a SABM or DISC may occur. In order to prevent this DM from being misinterpreted, all unsolicited DM frames should be transmitted with the F bit set to zero. All SABM and DISC frames should be sent with the P bit set to one, so there isn't any confusion when a DM frame is received.

Connectionless_Operation

In Amateur Radio circles, there is a type of operation that isn't really feasable using level 2 connections. This operation is the roundtable, where several amateurs may be engaged in one conversation. The only way to accomplish this in a connected mode would be to have everyone cross-connected with each other. This would require a seperate frame to be sent to each member of the roundtable every time someone says something. Obviously, this mode is not practical. The way most amateur packet radio enthusiasts have ended up implementing the roundtable operation is outside the AX.25 connection, but still using the AX.25 frame structure. AX.25 does allow a special frame for this operation, called the Unnumbered Information (UI) frame. It is recommended that when this type of operation is in use, the destination address have a code word installed in it to prevent the users of that particular roundtable from seeing all frames going thru the shared RF medium. An example of this is if a group of amateurs are in a roundtable discussion about packet radio, they could put PACKET in the destination address, so they would only receive frames from others in the same discussion. An added advantage of the use of AX.25 in this manner is that the source of each frame is in the source address sub-field, so software could be written to automatically display who is making what comments.

Admittedly, this is a kludge to the level 2 AX.25 protocol. THis type of operation really belongs at the next layer (layer 3, packet level) of operation, but until layer 3 is implemented, this appears to be an acceptable substitute.

Keep in mind that this mode is connectionless, so all transmitted frames should be of good quality, as there will be no requests for retransmissions of bad frames. Collisions will also occur, with the potential of losing the frames that collided.

List_of_System_Defined_Parameters

Timers

It is recommended that there are two timers used to maintain the integrity of the AX.25 layer 2 connection.

The first timer, T1, is used to make sure a device doesn't wait forever for a response to a frame it sends. This timer cannot be expressed in absolute time, since the time required to send frames varies greatly with the baud rate used at level 1. T1 should be at least twice the time it would take to send a maximum length frame to the other end of the link, and get the proper response frame back from the other end of the link. This would allow time for the other end of the link to do some processing before responding.

The second timer, T2, is used whenever T1 isn't running to make sure that a supervisory frame is sent periodically to maintain link integrity. It also will vary dramatically depending on layer 1 constraints, and is subject for further study.

Maximum_Number_of_Retrys_(N2)

The maximum number of retrys is used in conjunction with the T1 timer. It will vary depending on the layer 1 in use, but will generally be sixteen.

Maximum_Number_of_Octets_in_an_I_Field_(N1)

The maximum number of octets allowed in the I field will be 256. There should also be an even multiple number of octets.

Maximum_Number_of_I_Frames_Outstanding_(k)

The maximum number of outstanding I
frames at a time is seven. A smaller number may
be used at any time, provided it is agreed upon
ahead of time.

First
Bit Sent

Flag	Address	Control	FCS	Flag
01111110	112/168 Bits	8 Bits	16 Bits	01111110

Figure 1A. U and S Frame Construction

First
Bit Sent

Flag	Address	Control	PID	Info.	FCS	Flag
01111110	112/168 Bits	8 Bits	8 Bits	N*8 Bits	16 Bits	01111110

Figure 1B. Information Frame Construction

First
Octet Sent

Address Field of Frame	
Destination Address	Source Address
A1 A2 A3 A4 A5 A6 A7	A8 A9 A10 A11 A12 A13 A14

Figure 2A. Non-Repeater Address Field Encoding

First
Octet Sent

Address Field of Frame		
Destination Address	Source Address	Repeater Address
A1 A2 A3 A4 A5 A6 A7	A8 A9 A10 A11 A12 A13 A14	A15 A16 A17 A18 A19 A20 A21

Figure 2B. Repeater Address Field Encoding

Appendix A. Non-Repeater Frame Example

Octet	ASCII	Bin.Data	Hex Data
Flag		01111110	7E
A1	K	10010110	96
A2	8	01110000	70

A3	M	10011010	9A
A4	M	10011010	9A
A5	O	10011110	9E
A6	space	01000000	40
A7	SSID	01100000	60
A8	W	10101110	AE
A9	B	10000100	84
A10	4	01101000	68
A11	J	10010100	94
A12	F	10001100	8C
A13	I	10010010	92
A14	SSID	01100001	61
Control	SABM	00111111	3F
PID	none	11110000	F0
FCS	part 1	XXXXXXXX	HH
FCS	part 2	XXXXXXXX	HH
Flag		01111110	7E

The frame shown is an SABM frame, not going
thru a level 2 repeater, from WB4JFI (SSID=0) to
K8MMO (SSID=0), with no level 3 protocol.

Appendix B. Repeater Type Operation

Octet	ASCII |Bin.Data|Hex Data
Flag	|01111110| 7E
A1	K |10010110| 96
A2	8 |01110000| 70
A3	M |10011010| 9A
A4	M |10011010| 9A
A5	O |10011110| 9E
A6	space |01000000| 40
A7	SSID |01100000| 60
A8	W |10101110| AE
A9	B |10000100| 84
A10	4 |01101000| 68
A11	J |10010100| 94
A12	F |10001100| 8C
A13	I |10010010| 92
A14	SSID |01100000| 60
A15	W |10101110| AE
A16	B |10000100| 84
A17	4 |01101000| 68
A18	J |10010100| 94
A19	F |10001100| 8C
A20	I |10010010| 92
A21	SSID |11100011| E3
Control| SABM |00111111| 3F
PID	none |11110000| F0

```
| FCS | part 1|XXXXXXXX| HH |
| FCS | part 2|XXXXXXXX| HH |
| Flag | |01111110| 7E |
-----------------------------------
```

The above frame is the same as in Appendix A, but with the addition of a repeater address sub-field (WB4JFI, SSID=1). The H bit is set, indicating this is from the output of the repeater.

Appendix C.
Advantages of the WB4JFI Addressing Scheme

Some of the advantages to using this addressing system are:

1. Every packet station will have a unique fixed address that doesn't change every time a new network is logged into.

2. Relocating to a new area won't cause major (or minor) problems.

3. Allows for more than 62 or 31 users at a time.

4. No local packet guru is needed to assign addresses with attendant concerns of backup and transfer during failure.

5. Direct or network operation requires no change of address.

6. All the problems with dynamic allocation/de-allocation are eliminated.

7. Reduces local co-network interference due to users in overlapping local network rf domains with the same address fields.

8. With every frame having both the destination and source addresses in them, it will be a lot easier to set-up and run multiple connections on the same data channel without having problems arise as to who is sending what frames to whom.

9. In round-table operation, every frame sent will have the source address imbedded in it, allowing automatic printing of the source of the frame.

Appendix D. Layer 2 AX.25 State Table

```
-------------------------------------------------------------------------------------------
------------
----------------------------
| State |I with|I with-|RR with|RR with-|REJ with|REJ with-|RNR with|RNR with-| SABM | DIS
C | UA | DM | FRMR |
| | Poll |out P | Final |out F | Final |out F | Final |out F |either|eith
er| either| either | either |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S1 Disconnected | DM | | DM | | DM | | DM | |UA,S5 | DM
| |SABM,S2 | |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S2 Link Setup | | | | | | | | UA |DM,S
1 | S5 | S1 | |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S3 Frame Reject | FRMR | | FRMR | | FRMR | | FRMR | |UA,S5 |UA,S
1 | |SABM,S2 | SABM,S2|
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S4 Disconnect Rqst | | | | | | | | DM | UA
| S1 | S1 | |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S5 Information Xfr | RR | I | I | I | I | I | S9 | S9 | UA |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S6 REJ Frame Sent | RR,S5| I,S5 | I | I | I | I | S15 | S15 |UA,S5 |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
|-------------------------------------------------------------------------------------------
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----------------------------|
|S7 Waiting Acknow. | RR | I | I,S5 | I | I,S5 | I | S9 | S12 |UA,S5 |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
|-------------------------------------------------------------------------------------------
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----------------------------|
|S8 Device Busy | RNR | RNR | I | I | I | I | S10 | S10 | UA |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S9 Remote Device | RR | RR | I,S5 | I,S5 | I,S5 | I,S5 | | |UA,S5 |UA,S
```

```
1 |SABM,S2|SABM,S2 | SABM,S2|
| Busy | | | | | | | | |
| | | |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S10 Both Devices | RNR | RNR | I,S8 | I,S8 | I,S8 | I,S8 | | |UA,S8 |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
| Busy | | | | | | | | |
| | | |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S11 Waiting Acknow.| RNR | RNR | I,S8 | I | I,S8 | I | S10 | S13 |UA,S8 |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
| and Device Busy | | | | | | | | |
| | | |
|-------------------------------------------------------------------------------------------
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----------------------------|
|S12 Waiting Acknow.| RR | RR | I,S5 | I,S7 | I,S5 | I,S7 | | |UA,S5 |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
| and Remote Busy | | | | | | | | |
| | | |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S13 Waiting Acknow.| RNR | RNR | I,S8 | I,S11 | I,S8 | I,S11 | | |UA,S8 |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
| Both Devices Busy | | | | | | | | |
| | | |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S14 REJ Sent and | RNR | RNR | I | I | I | I | S16 | S16 |UA,S8 |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
| and Device Busy | | | | | | | | |
| | | |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S15 REJ Sent and |RR,S9 | RR,S9 | I,S6 | I,S6 | I,S6 | I,S6 | | |UA,S5 |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
| Remote Busy | | | | | | | | |
| | | |
|-------------------------------------------------------------------------------------------
------------
----------------------------|
|S16 REJ Sent and | RNR | RNR | I,S14 | I,S14 | I,S14 | I,S14 | | |UA,S5 |UA,S
1 |SABM,S2|SABM,S2 | SABM,S2|
```

```
| Both Devices Busy | | | | | | | | |
| | | |
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```

== Relayed by David Altekruse, W6RAW ==

```
-----BEGIN PGP SIGNATURE-----
Version: GnuPG v2.0.19 (FreeBSD)

iEYEARECAAYFAlFWlkcACgkQ6Pj0az779o7I1gCgthp5Gb+UslRyaCmzyCOznaCG
940An1EKrxckFjUqfPOihZqTQY0+OZVq
=0GqW
-----END PGP SIGNATURE-----
```

16. Ham Radio Now for Saturday 6 April 2013

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-04-06 08:11:14 UTC
From: rec-radio-info-request@panix.com
Message-ID: <e89a8f2343efd2ea7204d9acbed6@google.com>
Source record: 146
Cross-posted to: rec.radio.amateur.misc,rec.radio.amateur.digital.misc,rec.radio.info

Ham Radio Now

//
HamRadioNow: 10-10 International; Digital for Alabama ARES

Posted: 05 Apr 2013 04:59 PM PDT
http://hamradionow.tv

HAMRADIONOW EPISODES 71 and 72: Online Now

71: Ten-Ten International Net

10 meters is supposed to be hopping these days, but instead, it's limping. And when the sunspot cycle is near minimum, 10 stays dead for months on end. 10-10 International was formed to encourage 10 meter use all the time, initially to stave off a potential CB expansion back in the 60's. Now it's just to have fun on this quirky band. Jeff and Gary talk to Gerry Gross WA6POV, former 10-10 president, at the Orlando HamCation, to see what the group is all about.

72: Digital Modes for Alabama ARES

Alabama hams were early D-STAR adopters, led by the ARRL Section and ARES officials. And it's not just D-STAR. ARES hams are encouraged to experiment and adopt a variety of digital modes, and they're in use routinely. Gary talks to Section Manager Dave Drummond W4MD, and Assistant Section Manager Tommy Howell KG4MPU about how it's working.

17. [tapr-announce] Third Call for Articles

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-04-09 00:10:02 UTC
From: Stan Horzepa <stanzepa@sbcglobal.net>
Message-ID: <51635BF2.6060406@sbcglobal.net>
Source record: 147
Cross-posted to: rec.radio.amateur.digital.misc,rec.radio.info

Work on the next issue of TAPR's quarterly newsletter, PSR, is winding
down and this is the last call for articles for that issue, the Spring -
Pre-Hamvention issue of the newsletter.

The deadline for PSR is April 15. Please send your cards, letters,
articles, etc., whatever you have, to wa1lou@tapr.org

73,

WA1LOU - PSR Editor

_____
tapr-announce mailing list

NOTE: This list includes all addresses currently subscribed to any TAPR mailing list.
Please don't try to manually unsubscribe from this list; it won't work. If you unsubscribe
from all other TAPR mailing lists, you will automatically be unsubscribed from this one.

18. [tapr-announce] Last Call for Articles

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-04-15 00:41:28 UTC
From: Stan Horzepa <stanzepa@sbcglobal.net>
Message-ID: <516B4BC5.90504@sbcglobal.net>
Source record: 148
Cross-posted to: rec.radio.amateur.digital.misc,rec.radio.info

Monday, April 15, is the deadline for the Spring - Pre-Hamvention issue
of TAPR's quarterly newsletter, PSR. So please send your cards, letters,
articles, etc., whatever you have, to wa1lou@tapr.org

73,

WA1LOU, PSR Editor

_____
tapr-announce mailing list

NOTE: This list includes all addresses currently subscribed to any TAPR mailing list.
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from all other TAPR mailing lists, you will automatically be unsubscribed from this one.

19. May 2013 QST - Special Digital Communications Issue

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-04-15 14:32:56 UTC
From: ARRL Web site <memberlist@www.arrl.org>
Message-ID: <20130415135551.EFA5C203E5@bmail.arrl.org>
Source record: 149
Cross-posted to: rec.radio.amateur.moderated,rec.radio.amateur.digital.misc,rec.radio.info

May 2013 /QST/ Digital Edition - Now Available May 2013 edition
<http://www.nxtbook.com/nxtbooks/arrl/qst_201305/>
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*Special Dayton Hamventionï¿½**Section in this issue!*

* Build an 80 W linear amplifier for 2 meters.
* Try your first Arduino microcontroller project.
* Add FSK to a Tigertronics SignaLink interface.
* Follow a family DXpedition to Cyprus.
* Check out an ARRL convention in a Puerto Rican paradise.
* ... and much more!

Enjoy Content You Won't Find in the Print Edition

* Watch video overviews of the new Hendricks BitX17A transceiver and
the M^2 2M-1K2 high power 2 meter amplifier.

Every issue of /QST/ is filled with the news and features you need to
keep active in Amateur Radio. Enjoy this issue!

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<http://www.arrl.org/myarrl>.
Forgot password? Go to www.arrl.org/forgot-password
<http://www.arrl.org/forgot-password> to reset your password.
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20. Re: Ham Radio Now for Saturday 6 April 2013

Newsgroup: rec.radio.amateur.digital.misc
Date: 2013-05-04 12:20:21 UTC
From: Channel Jumper <Channel.Jumper.bcabed8@radiobanter.com>
Message-ID: <Channel.Jumper.bcabed8@radiobanter.com>
Source record: 150

Ham Radio Now via rec.radio.info Admin;803463 Wrote:
> Ham Radio Now
>
> //
> HamRadioNow: 10-10 International; Digital for Alabama ARES
>
> Posted: 05 Apr 2013 04:59 PM PDT
> http://hamradionow.tv
>
> HAMRADIONOW EPISODES 71 and 72: Online Now
>
>
>
> 71: Ten-Ten International Net
>
> 10 meters is supposed to be hopping these days, but instead, it's
> limping.
> And when the sunspot cycle is near minimum, 10 stays dead for months on
>
> end. 10-10 International was formed to encourage 10 meter use all the
> time,
> initially to stave off a potential CB expansion back in the 60's. Now
> it's
> just to have fun on this quirky band. Jeff and Gary talk to Gerry Gross
>
> WA6POV, former 10-10 president, at the Orlando HamCation, to see what
> the
> group is all about.
>
>
>
> 72: Digital Modes for Alabama ARES
>
> Alabama hams were early D-STAR adopters, led by the ARRL Section and
> ARES
> officials. And it's not just D-STAR. ARES hams are encouraged to
> experiment
> and adopt a variety of digital modes, and they're in use routinely. Gary
>
> talks to Section Manager Dave Drummond W4MD, and Assistant Section
> Manager
> Tommy Howell KG4MPU about how it's working.

I can't speak for the Ten Ten International group as a whole, but I wish they would eat crap and die.
Those people are WORSE then the CB radio when it comes to good operating practices.

Every time they have one of their crappy contests - they explode upon the band and just set up everywhere and anywhere and they do not follow the band plan.. I can mention two retards from Georgia as a example.
A husband and wife team that sets up on 28.400 and 28.415 - Chandra is the one I remembered talking to.

When you try to explain the band plan to them, they give every excuse from soup to nuts why they are operating on the CALL FREQUENCIES!

It only stands to reason that the very people they were trying to protect 1o meters from is the same that they turned into.

The collection of dues / have to pay to join 10 10 to participate, and the 10 10 numbers only helps to exacerbate the problem - not solve it.

I just give them my zip code - that messes with their heads!

--
Channel Jumper